Thermal Conductivity of Ionic Liquids - New Hot-Strip Sensors and Measurements

Ana Ribeiro, Maria José Lourenço [C, S], Fernando Santos and Carlos Nieto de Castro
Faculdade de Ciências da Universidade de Lisboa, Departamento de Química e Bioquímica, Lisboa, Portugal
mjvl@fc.ul.pt

One of the most important thermal properties for developing new engineering fluids compatible with the sustainable chemistry is thermal conductivity. Ionic liquids are a class of fluids that have shown lots of possibilities for replacing existing fluids in chemical processing plants, and in other heat transfer applications. Recently we have reported thermal conductivity values for several ionic liquids, obtained with commercial equipment, (KD2 Pro Thermal Properties Analyzer Decagon, USA) based on the transient hot-wire method, using an electrically insulated probe [1,2]. However, in spite of a very careful calibration, using toluene, water, glycerol, one mixture of glycerol + water, and NaCl + water solution (covering a range of thermal conductivities between 0.13 and 0.67 $Wm^{-1}K^{-1}$), the uncertainty of the data obtained was about 6.6 % (k=2). In this paper we report measurements on the thermal conductivity of for $[C_4mim][NTf_2]$, $[C_4mim][dca]$, $[C_2mim][EtOSO_3]$, [*Aliquat*][dca], $[P_{6,6,6,14}][dca]$ and [(di-h)tmg][dca] using new hot-strip sensors, inspired in our previous work [3,4,5]. The ionic liquids were characterized using NMR spectroscopy, elemental analysis, and mass spectrometry with an electrospray ionization source (ESI). The chloride ion content was determined by ion chromatography and the water content by coulometric Karl-Fisher titration (Metrohm 831 KF Coulometer) [6]. Characterization of these compounds showed that the chloride ion content was very small, the water content after especial drying was never greater than 120 ppm, and that the elemental analysis agrees very well with the theoretical expected values. The sensors were designed to accommodate the properties of the ionic liquids, and were obtained by PVD deposition of platinum in a ceramic substrate. The measuring system used has been previously described [7], and it is composed by an Automatic Wheatstone bridge, capable of measuring the temperature rise in the hot strip as a function of time. As attempt was made to design the sensors (length, width and thickness) to match as close as possible the transient hot-wire behaviour. A new cell was also designed, constructed mainly from Teflon®. Details of it will also be presented. The estimated accuracy of the current data is about 2% (k=2).

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